

AD-A067 743 CALIFORNIA UNIV LOS ANGELES GRADUATE SCHOOL OF MANAGEMENT F/G 9/2
ANNUAL REPORT, 1 APRIL 1978 - 31 MARCH 1979, (U)
MAR 79 B P LIENTZ

N00014-75-C-0266
NL

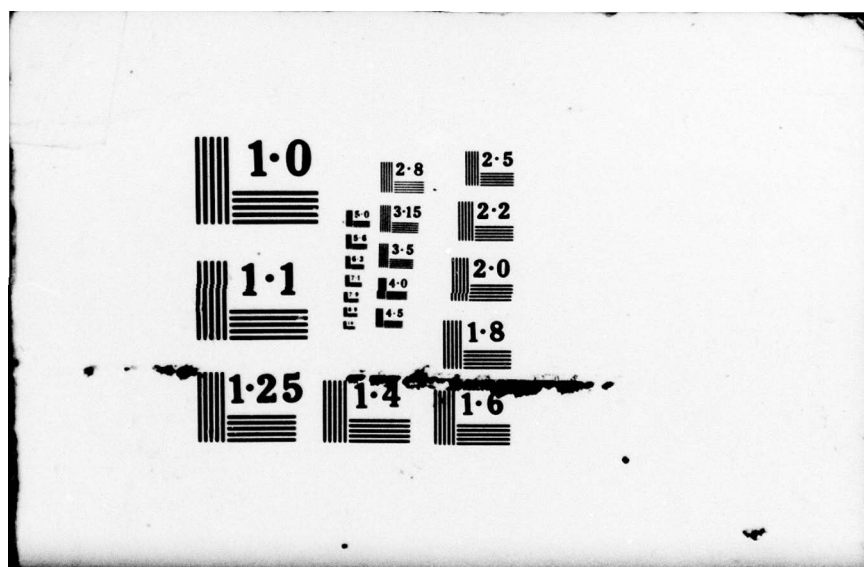
UNCLASSIFIED

1 OF 1
ADA
067743



END
DATE
FILMED

6-79
DDC



unclassified

A053803

12

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS
BEFORE COMPLETING FORM

1. REPORT NUMBER

Annual Report

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

Annual Report,
1 April 1978 -
31 March 1979

LEVEL

5. TYPE OF REPORT & PERIOD COVERED

Annual, April 1, 1978 -
March 31, 1979

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

Bennet P./Lientz

8. CONTRACT OR GRANT NUMBER(s)

N00014-75-C-0266

9. PERFORMING ORGANIZATION NAME AND ADDRESS

Graduate School of Management
University of California
Los Angeles, CA 90024

10. PROGRAM ELEMENT, PROJECT, TASK
AREA & WORK UNIT NUMBERS

NR049-345

11. CONTROLLING OFFICE NAME AND ADDRESS

Information Systems Program
Office of Naval Research, Arlington, Virginia

12. REPORT DATE

March 1979

13. NUMBER OF PAGES

6

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

12 7p.

15. SECURITY CLASS. (of this report)

unclassified

15a. DECLASSIFICATION/DOWNGRADING
SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

distribution of this document is unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

application software maintenance
computer security
computer networks

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report details the activities on contract N00014-75-C-0266, project
no. NR049-345, Information Systems Program, Office of Naval Research
for the period April 1, 1978 through March 31, 1979.

AD A067743

DDC FILE COPY

DDC
RECEIVED
APR 23 1979
REGISTRY
C

DD FORM 1473
1 JAN 73

EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

unclassified 407 436
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LB

ANNUAL REPORT

April 1, 1978 through March 31, 1979

Contract No: N00014-75-C-0266
Project No: NR-049-345
Information Systems Program
Office of Naval Research

Bennet P. Lientz, Principal Investigator
Graduate School of Management
University of California, Los Angeles

This report summarizes the work during the period April 1, 1978 through March 31, 1979 under contract N00014-75-C-0266. The persons supported during this period were Professor Lientz, Professor B. Swanson, several Ph.D and Masters students (Dr.Kweku Ewusi - Mensah, Mike Levy), and secretarial support.

The reports produced during this period were as follows:

1. Lientz, B. P. and E. B. Swanson, "Discovering Issues in Software Maintenance, Data Management, Vol. 10, pp. 15-18, 1978.
2. Lientz, B. P., E. B. Swanson, and G. L. Tompkins, "Characteristics of Application Software Maintenance," Communications of the ACM, Vol. 21, pp. 466-471, 1978.
3. Lientz, B. P. "A Multistage Model of Network Usage," Isletme Dergisi, Vol. 4, pp. 193-203, 1978.
4. Lientz, B. P. and M. Chen, "A Methodology for Long Range Information Services Planning," Long Range Planning, (to appear in Summer 1979).
5. Lientz, B. P. and E. B. Swanson, "On the Use of Productivity Aids in System Development and Maintenance," submitted to International Conference on Software Engineering, 1979.
6. Lientz, B. P. and E. B. Swanson "A Survey of Application Software Maintenance," Data Management (to appear in 1979).
7. Ewusi-Mensah, W. and B. P. Lientz, "On the Application of Peak Load Pricing to Computer Services," submitted for publication.
8. Lientz, B. P. and I. R. Weiss, "Trade-Offs of Secure Processing in Centralized versus Distributed Networks," Computer Networks, Vol. 2, pp. 35-43, 1978.

ACCESSION for	
NTIS	White Section
DDC	Buff. Sectic.
UNANNOUNCED	
JUSTIFICATION	
BY	DISTRIBUTION/AVAIL. ACT.
Dist.	AVAIL. a.
A	

79 04 18 063

↓
The publications highlight the major areas addressed in the research program: computer-communication systems and software maintenance. In the computer-communication area the work addressed applying a simulation model to demonstrate the ability to do trade-off analysis between security measures and computer performance, in terms of throughput and response time as well as cost (8). Additional work was done in the area of peak load pricing of network services (7). The emphasis here is to derive models for developing pricing policies using economic theory. In (3) a life cycle model is presented for the use of timesharing and interactive systems.

The major current effort is in the application software maintenance area. Data collected by an extensive survey has been analyzed and several reports have been produced. Lientz and Swanson (1) discuss software maintenance issues. The tabular results of the survey appear in (6).

One particular area of interest is the use of productivity aids. This has been documented in (5) and is being considered for presentation at the International Conference on Software Engineering. Another paper that is being developed reports the use of factor analysis in determining problem areas that affect maintenance effort. Analysis indicates that the predominant group of factors involve user needs, expectations and participation. The second group of factors involves management issues -- resource allocation, etc. The third group consists of technical issues, documentation, etc.

The pilot survey reported in (2) consisted on the first phase in maintenance. The second phase which included the expanded survey as reported in (1), (5), (6) provides an overall view of maintenance. Current effort has several foci:

- Continuation of analysis of data

79 04 18 063

- application to real DOD. Systems
- research stemming from survey work

The first of these has been addressed. The second area has begun. With the help of ONR staff members, contact was established with a maintenance group of the U. S. Marine Corps at Camp Pendleton, California. An initial visit was made. Results of the survey were presented. It is intended that this will be followed up by an exchange of documents and then by assistance to them in analyzing their current maintenance effort. Additional visits will be made in the next contract period.

Several areas of research have emerged from the survey work. One area is that of planning to control maintenance effort. This is reported in (4). It will be expanded to provide a methodology for development and maintenance in the next decade. A second area is that of creating and monitoring system requirements across the life cycle. This is being worked on. The third area is that of software cost estimation. The initial estimation effort will be in the maintenance area. It will consist of a classification method of systems change requests and measurement. If this is successful, an attempt will be made to extend the method into development.

During the year, a number of papers were presented. Professor Lientz presented invited papers at the EDP Auditors Association, the ORSA/TIMS annual meeting and the Data Processing Management Association (DPMA). Professor Swanson presented invited papers at the Systems Science Symposium, the TIMS-ORSA meeting, and the DPMA.

The remainder of this report summarizes some of the recent analysis of the maintenance survey data. The questionnaire asked managers to respond to a variety of problem factors as well as to the extent of maintenance. Four problem factors accounted for 88.9% of the problem variance using factor analysis. These were

- programmer effectiveness ($r=.191$, $s=.001$)
- product quality ($r=.191$, $s=.001$)
- user knowledge ($r=.113$, $s=.006$)
- programmer time availability ($r=.101$, $s=.013$)

Here r is the correlation measure and s is the significance level. Two other factors, system reliability and machine requirements, were less significant. Each of these factors is a cluster of specific problem areas identified in (6).

The problem area groupings are:

- | | |
|--------------------------------|--|
| - user knowledge | - lack of user understanding |
| | - inadequate user training |
| - programmer effectiveness | - maintenance programmer productivity |
| | - maintenance programmer motivation |
| | - skills of maintenance programmers |
| - product quality | - adequacy of system design specifications |
| | - quality of original programming |
| | - documentation quality |
| - programmer time availability | - competing demands for maintenance time |
| - machine requirements | - program storage requirements |
| | - program processing time requirements |

Using analysis of variance, the six problem factors were considered against the level of staffing sufficiency and the demands of maintenance on the manager's own time. It was found that four problem factors varied significantly by perceived level of staffing sufficiency:

- user knowledge ($s=.007$)
- programmer effectiveness ($s\leq.001$)
- product quality ($s\geq.001$)
- programmer time availability ($s\leq.001$)

For demands on the manager's own time, four factors varied significantly:

- user knowledge ($s=.005$)
- programmer effectiveness ($s\leq.055$)
- product quality ($s\leq.001$)
- system reliability ($s=.076$)

These results indicate that system reliability and machine requirements have a lesser effect. Several potential reasons for this are improved price performance of hardware, migration support to new hardware systems, and age indicating system stability.

Analysis was performed to see if system size and age have an influence on the perceived problems of maintenance. It was shown that age and size impact the magnitude and allocation of maintenance effort as expected. Size has no impact except for only machine requirements and system reliability. However, these accounted for only 11.1% of the total problem variance. System age had no notable influence on problem factors whatsoever.

Analysis of variance was performed for the six problem factors and system development tools. Of these factors product quality was affected by test data generators, structured walk-through and chief programming team.

However, it is noteworthy that the problems of user knowledge and programmer effectiveness, which account for 71.4% of the total problem variance, are little affected through the use of these techniques. Separate analysis revealed that greater problems of system reliability are seen to be associated with a data base dictionary. This may, perhaps, reflect the complexity of the system software incorporating the tool. No significant variances were found when the six problem factors were analyzed with the use of a data base management system.

It has been argued in the literature that maintenance effort depends on the choice of language. Using one way analysis of variance two factors were seen to vary significantly with language. These were programmer effectiveness ($s=.010$) and system reliability ($s=.080$). For programmer effectiveness problems tend to be greater than average where assembler languages are used and notably greater than average for PL/1 and FORTRAN. For RPG it is less than average. COBOL is average. This is not entirely unexpected since sophistication in a language may affect programmer effectiveness.